In this State (California) the disease is not uncommon among ground squirrels, as has been reported by McCoy and Chapin, who were the first to observe the disease and isolate the infecting organism, to which they gave the name *Bacterium tularense*.

This plague-like disease has never been observed heretofore in the rabbits of California. It will be of interest to note if an epizootic occurs among the rabbits in the district in which this rabbit was found.

Wherry and Lamb were able, by placing an infected rabbit in a runway with 15 other rabbits, to infect 5 out of the 15. They believed this result to be due to gastrointestinal infection.

SOME FALLACIES REGARDING PHENOL.

A REVIEW WITH REPORTS OF OBSERVATIONS ON THE INFLUENCE OF ETHYL ALCOHOL ON THE GERMICIDAL AND ON THE TOXIC PROPERTIES OF PHENOL.

By MARTIN I. WILBERT, Technical Assistant, Hygienic Laboratory, United States Public Health Service.

There are probably few official drugs regarding which more misleading statements have been made than phenol, or, as it is more widely known, carbolic acid. This substance was first recognized by Runge (1834), who called it carbolic acid to indicate its nature and origin; an oil-like liquid, obtained from coal, that has much in common with well-known acids. Phenol was early confounded with creosote, isolated by Reichenbach (1832) from beechwood tar, and under the name coal-tar creosote an impure commercial phenol was long listed and freely sold to less well-informed dealers, who unknowingly substituted this more poisonous commercial product for beechwood creosote for internal use.

With the advent of crystalline phenol and its subsequent use as an antiseptic in surgical practice, better informed medical practitioners began to appreciate the difference between the two products, but even at the present time it is not uncommon to find commercial grades of phenol referred to as coal-tar creosote.

The widespread use of phenol as an antiseptic and a disinfectant by medical practitioners served to bring it to the attention of the laity as a poison, and as early as 1890 it was asserted that phenol or carbolic acid was employed more frequently by suicides than any other drug.

The toxicology of carbolic acid early attracted attention, and a record of the substances that have been recommended as antidotes for phenol poisoning, with a review of the reasons for recommending them, would be an interesting study in that it would tend to emphasize the futility of basing conclusions on incomplete or at times misleading observations.

The use of fixed oils, of glycerin, and of diluted sulphuric acid, and the use of the soluble sulphates of the alkalies and alkali earths, while apparently justified on the basis of the earlier observations, have long since been recognized as being inefficient and in many instances distinctly harmful.

The rather widespread use of ethyl alcohol as an antidote for phenol poisoning and the studious avoidance of ethyl alcohol as a diluent for phenol used as an antiseptic or disinfectant, while long since shown to be based on erroneous reasoning, still persist and, as will be noted later, the belief in the efficiency of ethyl alcohol as a detoxicant for phenol appears to be growing rather than decreasing.

It was early found that alcohol is a better solvent for phenol than is water, and it was also found that mixtures of phenol with alcohol, fixed oils, glycerin, or camphor were less caustic than phenol alone, and under some conditions appeared to be less toxic than solutions of phenol in water.

Glycerin, it was early observed, will lessen the caustic local action of phenol on the skin, but experience has since shown that it will not prevent the production of gangrene nor the absorption of phenol.

A mixture of phenol and glycerin was recommended by Nathan Rosewater and others (Am. J. Pharm., 1895, v. 67, p. 221) as a safe and efficient substitute for phenol. In recommending this mixture, it was pointed out that "not being as caustic as phenol, it can not result in as much mischief or fatality if taken internally, either accidentally or on purpose."

Harrison Allen, as editor of A Handbook of Local Therapeutics (Philadelphia, 1897), makes the assertion that "carbolic acid dissolved in oil or in alcohol is inert. Anthrax spores were found to be unaffected after lying upward of three months in a 5 per cent solution of carbolic acid in oil and equally so by 70 days' exposure to a 5 per cent solution in alcohol. Even the sensitive anthrax bacilli were not destroyed by a 5 per cent solution of carbolic acid in oil."

Dr. Seneca D. Powell, of New York, was among the first to systematically recommend the use of alcohol as an antidote for phenol. He based his recommendation on the naive but evidently fallacious deduction that the action of alcohol in the stomach must be analogous to its action on the unbroken skin.

Phelps (N. Y. M. J., 1899, v. 69, p. 62) appears to have been the first to call attention in print to the antagonism of alcohol to phenol. He quotes Dr. Seneca D. Powell, who in his clinics at the Post-graduate Hospital demonstrated the antidotal value of alcohol by consecutively rinsing his hands in liquid phenol and then in alcohol.

Since that time alcohol has frequently been recommended and largely exploited as an antidote to carbolic acid, despite the fact that it

is of little value other than as a diluent. The exploitation of alcohol as an antidote and as a possible prophylactic for phenol poisoning has led to its recognition in State and other laws designed to restrict the sale and use of various poisons.

Williams (Drug. Circ., March, 1900, p. 46) was among the first to make the suggestion that, "in view of the frequently made assertion that grain alcohol is an efficient antidote for carbolic acid and that this poison may be taken with impunity if immediately followed by alcohol, it would appear that a mixture of phenol and grain alcohol would be a comparatively safe household preparation. The claim of the comparative innocuousness of carbolic acid under the conditions named is apparently well founded."

This fallacious suggestion has been embodied in several State and local laws and regulations designed to restrict the sale of carbolic acid. These laws usually provide that the requirements embodied therein do not apply to the sale of crude carbolic acid or to the sale of a solution or mixture containing equal proportions of carbolic acid, glycerin, and alcohol. That this misleading statement, originally made more than 20 years ago, is still a factor in the enactment of restrictive legislation is apparent from a paragraph embodied in the recently (1915) enacted laws of California and of Utah. These laws provide that the restrictions relating to the sale of carbolic acid do not apply to solutions of carbolic acid ("phenol") containing not over 10 per cent of carbolic acid ("phenol") and not less than 10 per cent of ethyl alcohol.

The same line of reasoning which led to the belief that ethyl alcohol is an efficient prophylactic and antidote for phenol because of its power of removing phenol from the skin also led to a rather widespread belief that mixtures of phenol with alcohol or solutions of phenol and alcohol in water are less efficient as antiseptics or disinfectants.

Taylor (J. Biol. Chem., 1908–9, v. 5, p. 319) in a report of an experimental study with alcohol-resistant yeasts to determine the antagonism of alcohol to phenol, concludes that this supposition appears to have some physical basis but is not due to any chemical detoxication of phenol by ethyl alcohol. From his experiments he concludes that alcohol does not reduce in the least the antiseptic action of carbolic acid, the toxicity of the phenol not being at all involved. With a high concentration of alcohol and a low concentration of phenol the alcohol seemed to increase to some extent the antiseptic value of the phenol.

Taylor concludes "that there is no chemical detoxication of phenol by ethyl alcohol and that the effects observed in therapeutic practice must rest upon some physical basis." He also points out that recent investigations by Sollmann support this conclusion.

Zemp (N. Y. M. J. 1909, v. 89, p. 476) appears to have been among the first to question seriously the value of ethyl alcohol as an antidote to phenol. He says: "That alcohol is a splendid solvent for many drugs is recognized by all. It is because of this power that it has been recommended as an antidote to carbolic acid. No chemical action takes place when these two drugs are brought together. The carbolic acid is simply diluted, hence its caustic power is diminished."

Macht (J. H. Hosp. Bull. 1915, v. 26, p. 98–104) reports an experimental study of lavage in acute carbolic acid poisoning in which he clearly demonstrates that contrary to popular experience and belief the internal use of alcohol in cases of phenol poisoning may be unfavorable. The conflicting opinions in regard to the use of alcohol are somewhat reconciled by his investigations. He finds that the influence of alcohol depends on the time of administration. If it is given after the ingestion of phenol, as must be the case therapeutically, the symptoms will be aggravated, the alcohol acting as an excellent solvent for phenol, promoting rather than retarding its absorption, so that death may actually be hastened. On the other hand, he found that an animal previously intoxicated with alcohol can withstand better the effects of phenol taken afterwards.

To determine the relative influence of ethyl alcohol and of glycerin on the actions of phenol it was thought desirable to repeat in a modified way some of the experiments previously reported. The results of these experiments are appended and clearly show that ethyl alcohol in the presence of water has no appreciable influence on the toxicity or on the germicidal properties of phenol and that it may therefore be advantageously used as a solvent alone, or in mixtures to promote the solubility of phenol in water for use as a germicide or disinfectant.

The experiments to determine the germicidal value of mixtures of phenol and alcohol and of phenol and glycerin were made in the Hygienic Laboratory by Mr. Albert F. Stevenson and Miss Rose Parrott.

The technic followed was that described in Hygienic Laboratory Bulletin No. 82: "The determination of the phenol coefficient of some commercial disinfectants," by Thomas B. McClintic.

The results, as evidenced in the appended tables, clearly show that in the presence of water both alcohol and glycerin are practically inert so far as any detoxicating action may be concerned.

In the presence of a larger percentage of alcohol there appears to be some increased activity, due probably to a slight increase in the solvent and penetrative properties of the mixture.

An abstract of a report on the effect of alcohol on the toxicity of phenol, made by Dr. Liston Paine, Assistant Surgeon, United States

Public Health Service, is also appended. The results noted serve to emphasize the findings previously reported and suggest the fallacy of enacting legislation designed to promote the sale of mixtures of phenol and alcohol under the impression that ethyl alcohol will serve as a detoxicant to phenol.

In conclusion, it may be again noted that the experimental work clearly shows that the addition of ethyl alcohol to phenol not only increases the solubility of phenol in water, but also increases rather than diminishes the antiseptic value of the resulting solution. Ethyl alcohol can be used to advantage as a substitute for glycerin in making antiseptic solutions of phenol.

The experiments with animals clearly show that the addition of ethyl alcohol to solutions of phenol in water does not, in any way, inhibit the toxic action of phenol, but rather tends to facilitate absorption and thus hasten death.

TABLE No. 1.—*Standard phenol in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	+	−	−	−	−	−
	1:110	+	+	−	−	−	−
	1:120	+	+	+	+	+	−

TABLE No. 2.—*A mixture of phenol 1 and glycerin 1 in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	+	−	−	−	−	−
	1:110	+	+	−	−	−	−
	1:120	+	+	+	+	+	−

TABLE No. 3.—*A mixture of phenol 1 and alcohol 1 in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	+	−	−	−	−	−
	1:110	+	+	−	−	−	−
	1:120	+	+	+	+	+	+

TABLE No. 4.—*A mixture of phenol 1 and alcohol 3 in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	+	−	−	−	−	−
	1:110	+	−	−	−	−	−
	1:120	+	+	+	−	−	−

TABLE No. 5.—*A mixture of phenol 1 and alcohol 9 in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15.
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	−	−	−	−	−	−
	1:110	−	−	−	−	−	−
	1:120	+	−	−	−	−	−

TABLE No. 6.—*A mixture of phenol 1 and denatured alcohol 1 in water.*

RESULTS OF A TEST (WITHOUT ORGANIC MATTER).

(+ means growth; − means no growth.)

Sample.	Dilution.	Time culture exposed to action of disinfectant in minutes.					
		2½	5	7½	10	12½	15
Phenol	1:80	−	−	−	−	−	−
	1:90	−	−	−	−	−	−
	1:100	−	−	−	−	−	−
	1:110	+	−	−	−	−	−
	1:120	+	+	+	+	−	−

The Effect of Alcohol or Glycerin on the Toxicity of Phenol as shown by Inoculations into White Mice.

(An abstract of a report by Dr. Liston Paine, assistant surgeon, United States Public Health Service.)

For the experiments recorded in the appended tables the technic was practically as outlined in Hygienic Laboratory Bulletin No. 88: Method for Determining the Toxicity of Coal-Tar Disinfectants, by Worth Hale.

The mice used were prepared in the afternoon of the day before they were to be injected, so as to insure a maximum of time for observing the development of symptoms.

The symptoms manifested by the mice referred to in the accompanying tables were typical of phenol poisoning. The mice that were injected with a mixture of phenol and alcohol or phenol and glycerin showed the symptoms just as early and to as marked an extent as the mice receiving phenol alone.

To determine the effect of ethyl alcohol, a solution containing twice as much alcohol as the maximum amount used with phenol was injected. All of these mice recovered within 24 hours, though all were stupified from the effect of the alcohol and three appeared to be moribund.

On injecting the same mice on the following day with an aqueous solution to determine whether such previously alcoholized mice could better resist the toxic action of phenol it was found that three died from approximately the same dose that proved fatal for other animals. (See Table E.) It should be noted in this connection that in this series of mice the phenol was injected after the mice had apparently recovered from the effects of the alcohol. It is probable that most of the alcohol had been excreted through one or another channel within the intervening 24-hour period.

In the appended tables an effort has been made to include only the essential information recorded in the protocols. The dose per mouse and dose per gram of mouse represent the weight of phenol in the solutions used.

TABLE A.—*One per cent phenol in water.*

Mouse No.	Weight.	Approximate amount of 1 per cent solution of phenol per mouse.	Phenol per gram weight of mouse.	Result.	Time.
	Grams.				*H. m.*
298	16.4	0.427	0.00026	Survived	.. ..
299	19.65	.512	.00026	.....do	.. ..
300	18.5	.582	.00032	.....do	.. ..
301	19.85	.632	.00032	.....do	.. ..
302	18.75	.712	.00038	Died	..
303	20	.761	.00038	Survived	.. 3
304	19	.875	.00046	Died	1 0
305	20.4	.958	.00046	.....do	20 04

TABLE B.—*One per cent phenol in distilled water (containing 3 c. c. of 95 per cent alcohol per 100 c. c. solution).*

Mouse No.	Weight.	Approximate amount of 1 per cent solution of phenol per mouse.	Phenol per gram weight of mouse.	Result.	Time.
	Grams.				*H. m.*
306	16.75	0.437	0.00026	Survived	.. ..
307	19.7	.513	.00026	.....do	.. ..
308	18.5	.582	.00032	.....do	.. ..
309	19.9	.637	.00032	.....do	.. ..
310	18.9	.719	.00038	.....do	.. ..
311	20.1	.765	.00038	Died	3 45
312	19.05	.877	.00046	.....do	1 30
313	21	.966	.00046	.....do	45

TABLE C.—*One per cent phenol in distilled water (containing 9 c. c. of 95 per cent alcohol per 100 c. c. solution).*

Mouse No.	Weight.	Approximate amount of 1 per cent solution of phenol per mouse.	Phenol per gram weight of mouse.	Result.	Time.
	Grams.				*H. m.*
370	16.60	0.432	0.00026	Survived	.. ..
371	20.95	.545	.00026	.....do	.. ..
372	18.25	.583	.00032	Died	.. 35
373	21.65	.693	.00032	.....do	10 20
374	19.95	.758	.00038	.....do	10 15
375	23.35	.887	.00038	Survived	.. ..
376	20.75	.955	.00046	Died	3 30
377	25.60	1.176	.00046	.....do	5 0

TABLE D.—*One per cent phenol, 1 c. c. glycerin in 100 c. c. solution (distilled water).*

Mouse No.	Weight.	Approximate amount of 1 per cent solution of phenol per mouse.	Phenol per gram weight of mouse.	Result.	Time.
	Grams.				*H. m.*
330	16.2	0.422	0.00026	Survived	.. ..
331	19.15	.498	.00026	.....do	.. ..
332	16.8	.538	.00032	.....do	.. ..
333	19.55	.625	.00032	.....do	.. ..
334	17.2	.654	.00038	Died	.. 25
335	21.1	.802	.00038	Survived	.. ..
336	17.5	.805	.00046	Died	1 15
337	23	1.06	.00046	.....do	3 30

TABLE E.—*One per cent phenol in water (mice had been injected the day before with varying amounts of an 18 per cent solution of ethyl alcohol).*

Mouse No.	Weight.	Approximate amount of 1 per cent solution of phenol per mouse.	Phenol per gram weight of mouse.	Result.	Time.
	Grams.				*H. m.*
378	16.95	0.543	0.00032	Survived	.. ..
379	18.35	.588	.00032	....do	.. ..
380	18.95	.721	.00038	Died	3 0
381	20.45	.780	.00038	Survived	.. ..
382	21.05	.968	.00046	Died	20 0
383	20.65	.950	.00046	....do	35 0

PLAGUE-PREVENTION WORK.

CALIFORNIA.

The following report of plague-prevention work in California for the week ended April 8, 1916, was received from Surg. Boggess, of the United States Public Health Service, in charge of the work:

SAN FRANCISCO, CAL.

RAT PROOFING.

New buildings:	
Inspections of work under construction	217
Basements concreted (square feet, 19,475)	21
Floors concreted (square feet, 11,147)	8
Yards, passageways, etc. (square feet, 8,801)	59
Total area of concrete laid (square feet)	39,423
Class A, B, and C (fireproof) buildings:	
Inspections made	138
Roof and basement ventilators, etc., screened	515
Wire screening used (square feet)	2,740
Openings around pipes, etc., closed with cement	945
Sidewalk lens lights replaced	1,000
Old buildings:	
Inspections made	438
Wooden floors removed	55
Yards and passageways, planking removed	29
New foundation walls installed (cubic feet)	5,150
Concrete floors installed (square feet, 32,710)	23
Basements concreted (square feet, 43,355)	58
Yards and passageways, etc., concreted (square feet, 35,851)	117
Total area concrete laid (square feet)	111,916
Floors rat proofed with wire cloth (square feet, 1,375)	3
Buildings razed	29

SAN FRANCISCO, CAL.—Continued.

RAT PROOFING—continued.

New garbage cans stamped approved	479
Nuisances abated	350

OPERATIONS ON THE WATER FRONT.

Vessels inspected for rat guards	18
Reinspections made on vessels	23
New rat guards procured	15
Defective rat guards repaired	10
Rats trapped on wharves and water front	10
Rats trapped on vessels	31
Traps set on wharves and water front	70
Traps set on vessels	54
Vessels trapped on	8
Poisons placed within Panama-Pacific International Exposition grounds (pieces)	56,200
Bait used on waterfront and vessels, bacon (pounds)	4

RATS COLLECTED AND EXAMINED FOR PLAGUE.

San Francisco:	
Collected	370
Examined	295
Found infected	None.
Hollister:	
Collected	1
Examined	1
Found infected	None.

RATS IDENTIFIED.

Mus norvegicus	190
Mus rattus	59
Mus alexandrinus	73
Mus musculus	48